TOXECON™ RETROFIT FOR MERCURY AND MULTI-POLLUTANT CONTROL ON THREE 90-MW COAL-FIRED BOILERS

Quarterly Technical Progress Report
Reporting Period: October 1, 2004 – December 31, 2004

Prepared by
Richard E. Johnson
Wisconsin Electric Power Company
333 West Everett Street
Milwaukee, WI 53203

January 26, 2005

DOE Cooperative Agreement No. DE-FC26-04NT41766

Theodore J. McMahon
USDOE Contracting Officer's Representative

DOE Report No. 41766R03

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ABSTRACT

With the Nation's coal-burning utilities facing tighter controls on mercury pollutants, the U.S. Department of Energy is supporting projects that could offer power plant operators better ways to reduce these emissions at much lower costs. Sorbent injection technology represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. It involves injecting a solid material such as powdered activated carbon into the flue gas. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by a particulate control device along with the other solid material, primarily fly ash.

We Energies has over 3,200 MW of coal-fired generating capacity and supports an integrated multi-emission control strategy for SO_2, NO_x, and mercury emissions while maintaining a varied fuel mix for electric supply. The primary goal of this project is to reduce mercury emissions from three 90-MW units that burn Powder River Basin coal at the We Energies Presque Isle Power Plant. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON™ system designed to clean the combined flue gases of units 7, 8, and 9 at the Presque Isle Power Plant.

TOXECON™ is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particle control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. For this project, the flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while NO_x and SO_2 will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON™ baghouse will provide enhanced particulate control. Sorbents will be injected downstream of the existing particle collection device to allow for continued sale and reuse of captured fly ash from the existing particulate control device, uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e., mercury recovery from the sorbent, will be explored and evaluated. For mercury concentration monitoring in the flue gas streams, components available for use will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment. This project will provide for the use of a novel multi-pollutant control system to reduce emissions of mercury while minimizing waste, from a coal-fired power generation system.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Wisconsin Electric Power Company (We Energies) signed a Cooperative Agreement with the U.S. Department of Energy (DOE) in March 2004 to fully demonstrate TOXECON™ for mercury control at the We Energies Presque Isle Power Plant. The primary goal of this project is to reduce mercury emissions from three 90-MW units (units 7, 8, and 9) that burn Powder River Basin (PRB) coal. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions, allow for reuse and sale of fly ash, demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment, and demonstrate a process to recover mercury captured in the sorbent.

We Energies has teamed with ADA-ES, Inc., (ADA-ES) and Cummins & Barnard, Inc., (C&B) to execute this project. ADA-ES is providing engineering and management on the mercury measurement and control systems. Cummins & Barnard is the engineer of record and will be responsible for construction, management, and start-up of the TOXECON™ equipment.

This project was selected for negotiating an award in January 2003. Preliminary activities covered under the "Pre-Award" provision in the Cooperative Agreement began in March 2003. This quarterly report summarizes progress made on the project from October 1, 2004, through December 31, 2004. During this reporting period, work was conducted on Tasks 4, 5, 6, 7, 8, 9, 11, and 19.

INTRODUCTION

DOE awarded Cooperative Agreement No. DE-FC26-04NT41766 to We Energies to demonstrate TOXECON™ for mercury and multi-pollutant control, a reliable mercury continuous emission monitor (CEM), and a process to recover mercury captured in the sorbent. Under this agreement, We Energies is working in partnership with the DOE.

Quarterly reports will provide project progress, results from technology demonstrations, and technology transfer information.

Project Objectives

The specific objectives of this project are to demonstrate the operation of the TOXECON™ multi-pollutant control system and accessories, and:

- achieve 90% mercury removal from flue gas through activated carbon injection,
- evaluate the potential for 70% SO_2 control and trim control of NO_x from flue gas through sodium-based or other novel sorbent injection,
- reduce PM emission through collection by the TOXECON™ baghouse,
- recover 90% of the mercury captured in the sorbent,
- utilize 100% of fly ash collected in the existing electrostatic precipitator,
- demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment, and
- successfully integrate and optimize TOXECON™ system operation for mercury and multi-pollutant control.

Scope of Project

The "TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers" project will be completed in two Budget Periods. These two Budget Periods are:

Budget Period 1: Project Definition, Design and Engineering, Prototype Testing, Major Equipment Procurement, and Foundation Installation.

Budget Period 2: CEM Demonstration, TOXECON™ Erection, TOXECON™ Operation, and Carbon Ash Management Demonstration.

As indicated by the title, Budget Period 1 initiates the project with project definition activities including NEPA, followed by design, which includes specification and procurement of long lead-time major equipment, and installation of foundations. In addition, testing of prototype mercury CEMs will be conducted.

Following in Budget Period 2, the TOXECON™ system will be constructed and operated. Operation will include optimization for mercury control, parametric testing for SO_2 and NO_x

control, and long-term testing for mercury control. The mercury CEM and sorbent regeneration processes will be demonstrated in conjunction with the TOXECON™ system operation.

Each task is described in the Statement of Project Objectives (SOPO) that is part of the Cooperative Agreement. For reference in this and future quarterly reports, the original SOPO for this project can be found in Appendix B.

EXPERIMENTAL

None to report.

RESULTS AND DISCUSSION

Task 4 – Balance of Plant (BOP) Engineering

Design work continued this quarter on the baghouse, ash handling, compressed air, major foundations, ductwork, structural steel, auxiliary electrical systems, electrical equipment enclosure and DCS I/O development. Major design efforts during this period were in the following areas:

- Review of Baghouse vendor drawings.
- Review of Booster fan vendor drawings.
- Review of Flyash system vendor drawings.
- Review of Damper vendor drawings.
- Completed design and release of construction drawings for superstructure foundations.
- Foundation design was completed for ductwork support steel, booster fans, PAC silo, and ash silo. Miscellaneous equipment pads and foundations are in progress.
- Ductwork and major structural steel design was completed. Miscellaneous steel design including platforms is in progress.
- Balance of plant electrical system design is in progress.
- Additional electrical work, 2.4kV switchgear upgrade and bus work design and preparation of the equipment specifications is in progress.
- The electrical equipment enclosure specification was completed.
- PAC System scope of work was completed.
- Control engineering design is in progress and includes DCS architecture definition, definition of I/O, defining field instrumentation continues and logic for various systems.
- The electrical construction contract package specification is currently being developed.
- Structural Steel and ductwork design was completed.
- Ductwork and baghouse model testing was completed, a site visit during testing was made and a draft report is being evaluated.

Task 5 – Process Equipment Design and Major Equipment Procurement

The following major equipment contract packages were awarded during this period.

Ductwork awarded	December 8, 2004
Ductwork & Fan Enclosure Steel awarded	December 8, 2004
Electrical equipment enclosure awarded	December 10, 2004

Major efforts during this period were in the following areas:

- Ductwork and support steel bid drawings and bid packages were issued for bids, 8 bids were received for structural steel fabrication and 7 bids for ductwork fabrication, bids were evaluated and contracts awarded to Merrill Iron and Steel for the Ductwork and Cives Steel Company for the structural steel.
- The superstructure construction contract package specification and drawings were completed and are currently out for bids with four bidders, with bids due January 17, 2005.
- The electrical equipment enclosure fabrication contract was issued for bids, 3 bidders responded. The bids were evaluated and an award made to Atkinson Industries.
- Completed specification for air compressors and air dryers and issued for bids, bids are currently being evaluated.
- Completed specification for ductwork expansion joints and issued for bids, bids are currently being evaluated.
- Currently two major equipment procurement packages are out for bids, the electrical motor control centers and the 2.4kV switchgear fabrication.
- See Appendix A for assessment of bid packages prepared by C&B for each item of equipment. Important design features, performance requirements, functional characteristics, and specifications are presented. Included in the Appendix is an overview of the important factors that went into evaluating and selecting the vendors.

Task 6 – Prepare Construction Plan

Work on the construction plan is in the final phase for issue. The plan was developed and sent to We Energies for review. Comments were received and are currently being incorporated. Issuance is in January, 2005.

Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment

Activities under Task 7 will be performed in both Budget Periods 1 and 2.

CEM Component Evaluation

ADA-ES's role in this task is to evaluate CEM components in real flue gas and provide feedback on operation and performance to Thermo Electron. In general, test sites are chosen to coincide with other mercury measurement testing being conducted by ADA-ES. This allows for real-time comparison of the new components with data from proven Semi-Continuous Emission Monitors (S-CEMs). During this reporting period, testing was conducted at Ameren's Meramec Station and at US Gen's Brayton Point Station.

Testing at Meramec was conducted in October and December 2004. The Thermo analyzer was installed in parallel with ADA-ES' S-CEM. Meramec fires PRB coal. Although testing at this site was limited to about eight days, this was sufficient time to perform an initial assessment of modified or new components, including:

1. Extraction probe – modifications were made to the temperature control software and to the layout to allow integration of a converter;

2. Converter – two new technologies were tested;
3. Calibrator – software upgrades were made; and
4. Analyzer – software and temperature control upgrades were made.

Brayton Point was chosen as a test site because this plant fires a bituminous coal that should challenge the converter and it is close to Thermo offices, which allows Thermo engineers access to flue gas to quickly evaluate components. ADA-ES does not have a S-CEM set-up at this site.

Component evaluations were conducted at Brayton Point in November and December 2004. In December, Thermo requested that ADA-ES bring wet chemical impinger solution traps to the site to help with the evaluation of a prototype converter. Comparison tests with the wet chemistry system lasted about three days. Testing will continue at this site during the first few months of 2005.

ADA-ES was granted permission to set-up a test-bed at a local power plant that fires a western bituminous coal. Testing to date has shown that once a component is installed and operational, the initial assessment only takes about a day. Testing at this site will begin in January and will probably continue through February.

A goal is to have the beta version of the instrument ready for long-term tests in February. Currently three beta analyzers will be available, with plans being put into place to build a fourth. The schedule is to have one analyzer at Presque Isle and have the other two analyzers available for evaluation at two different EPA test sites. The fourth analyzer will be installed at different sites where comparison performance data with a S-CEM can be obtained. These tests are important so that CEM performance can be evaluated in flue gas from as many different coals and plant equipment configurations as possible.

The four development stages are:

1. Prototype – laboratory tested, but first time in the field
2. Alpha – field tested, but still requires development on major issues (current research grade)
3. Beta – most of the bugs have been worked out, but still troubleshooting and conducting long term testing for commercial applicability
4. Commercial – Production grade component that can be purchased from the supplier

A summary of past, current and future test sites is presented in Table 1.

Table 1. Mercury CEM Test Sites

Test Site	Test Dates	Fuel/Configuration	Components Tested and Development Stage
Sunflower Electric Holcomb Station	July and August 2004	PRB/Spray Dryer and Fabric Filter	Extraction Probe - Alpha Analyzer - Alpha Calibrator - Prototype
Unidentified high sulfur site	August 2004	High sulfur, high ammonia, high temperature flue gas	Analyzer - Alpha Converter - Prototype
Ameren's Meramec Station	October 2004	PRB/ESP	Extraction Probe - Alpha Analyzer - Alpha Calibrator - Alpha Converter - Prototype
U.S. Gen's Brayton Point	October – December 2004	Low sulfur Bituminous/ ESP	Extraction Probe - Beta Analyzer - Beta Calibrator - Alpha Converter - Prototype
Western Bituminous Site	January – February 2005	Low sulfur, western Bituminous/FF	Extraction Probe - Beta Analyzer - Beta Calibrator - Beta Converter –Beta
We Energies Presque Isle	January – September 2005	PRB/Hot-Side ESP	Extraction Probe - Beta Analyzer - Beta Calibrator - Beta Converter - Beta
EPA Test Site 1	February – June 2005	Low sulfur bituminous/ESP	Extraction Probe - Beta Analyzer - Beta Calibrator - Beta Converter - Beta
EPA Test Site 2	March – June 2005	???/ESP	Extraction Probe - Beta Analyzer - Beta Calibrator - Beta Converter - Beta

Site Progress

Mercury removal will be measured across the TOXECON™ baghouse with two CEM's: one at the inlet, upstream of carbon injection and one at the outlet. The outlet extraction probe will be installed in a set of test ports immediately downstream of the baghouse, before the duct splits into three smaller ducts. The extraction location at the inlet is being finalized based on the flow model study, but at this time it is expected that there will be three

extraction points, one in each of the three ducts coming out of the APH's from Units 7, 8, and 9. These samples will be combined to give an average inlet mercury concentration.

A shelter will be needed for each CEM. A CEM shelter previously used at We Energies' Port Washington Station will be used at the inlet location. This shelter was refurbished and delivered to Presque Isle in November 2004. It was placed under the extraction location on the Unit 8 duct. A new shelter will be purchased for the outlet location.

Task 8 – Mobilize Contractors

CaTS is proceeding with managing the field construction work. Staff during this period included the construction manager, construction engineer, a safety coordinator and administrative clerk, and one engineer from We Energies for field support of the substructure foundation contract work along with associated mechanical and electrical work.

Task 9 – Foundation Erection

Progress this period for the substructure contract included completing the baghouse and PAC silo foundations, and partially completing the fan enclosure foundations, fan and motor pedestals and ash silo foundations. About half of the ductwork support foundations remain. Completion of all work is scheduled for late January, 2005.

Work continues with the following status during this period:

Activity	Status
Baghouse foundation	Completed December 10, 2004
Fan Enclosure foundation	In progress 75% Complete
Fan and motor pedestals	In progress 85% Complete
PAC silo foundation	Complete December 24, 2004
Ash silo foundation	In progress 90% Complete
Ductwork support foundations	In progress 50% Complete

Figures 1 and 2 at the end of this section are photos showing progress on the foundation work at the site.

Task 11 – Balance of Plant Mechanical and Civil/Structural Installation

The Unit 7 tie-in damper contractor was mobilized September 28 and completed the work in early November. This is a partial installation, turning vanes and purge air equipment still needs to be installed.
*Note: this work was originally planned for Budget Period 2, but was allowed per agreement with DOE NETL to be conducted during Budget Period 1

Task 17 – Carbon – Ash Management System

No work was done on this task during this period.

Task 19 – Reporting, Management, Subcontracts, Technology Transfer

Under this task reports, as required in the Financial Assistance Reporting Requirements Checklist and the Statement of Project Objectives are prepared and submitted. Subcontract management, communications, outreach, and technology transfer functions are also performed under this task.

Items Delivered During the Quarter

- Quarterly Technical Progress Report
- Quarterly Financial Status Report
- Quarterly Federal Assistance Program/Project Status Report
- An Environmental Health and Safety Approvals letter was prepared and delivered to NETL
- A presentation and site visit was arranged for the Michigan Department of Environmental Quality
- A presentation was made about the project to the UP Economic Development Association Annual Meeting in Iron Mountain, MI
- A Continuation Application was prepared and submitted to NETL. This was approved in December 2004.
- Two interviews were made with a Marquette TV station (Channel 6), one of which was a 10 minute slot on a program called "The Ryan Report"

CONCLUSION

This is the third Technical Progress Report under Cooperative Agreement No. DE-FC26-04NT41766. Work continued in the TOXECON™ system design and engineering. Procurement of several major items of equipment was also done during the quarter. Work continued in the evaluation of components for a mercury continuous emissions monitor system.

REFERENCES

None this reporting period.

Figure 1. View of Presque Isle Power Plant showing foundation installation.

Figure 2. Another view of Presque Isle Power Plant showing foundation installation.

Appendix A -
Bid Evaluation Overview

ELECTRICAL EQUIPMENT ENCLOSURE
STRUCTURAL STEEL
DUCTWORK

Electrical Equipment Enclosure Evaluation

Specifications

Technical Specification 4937E1 requested a firm price for furnishing an electrical equipment enclosure with a 10kVA uninterruptible power supply, specified electrical equipment, interior lighting, heating and ventilating system access doors and insulated floor, walls and roof. Enclosure size was defined in order to accept owner specified equipment and cabinets. Price to include the installation of owner furnished DCS panels.

Technical Evaluation Criteria

Uninterruptible Power Supply
Transformers
HVAC
Network system and terminations
Dimensional sizing

Economic Cost Criteria

Overall Price

Intangible Criteria

Experience with Comparable Projects
Construction Methods

Structural Steel Evaluation

Specifications

Specification 4937S3 requested a firm price, lump sum bid to supply and shop fabricate structural steel. The structural steel for the TOXECON™ Retrofit Project at Presque Isle Units 7, 8 and 9 is to support the new ductwork connecting the existing Units flue gas discharges to the new fabric filter as well as create the envelope structure for a building enclosing the ID Booster Fans. The scope of work for the contract includes:

- Design of member end connections.
- Preparation of steel fabrication drawings
- Preparation of erection drawings.
- Fabrication of structural steel and misc. steel/assemblies.
- Submittal of all calculations and drawings for engineer review.
- Submittal of all material and coatings information for engineer review.
- Application of required coatings for structural steel and steel assemblies.
- Testing and inspection as required by specification.
- Shipment of all fabricated steel to site.
- Technical support for interpretation of erection drawings.
- Field support for resolution of fit-up errors or complications.

The specification defined a scope of material supply, shop fabrication, and delivery. Installation/erection of the ductwork will be assigned to the Erection Contractor.

Commercial Evaluation Criteria

Terms and Conditions
Terms of Payment

Economic Evaluation Criteria

Overall Price
Unit Rates
Schedule
Extent of Shop Fabricated Assemblies

Intangible Criteria

Experience with Comparable Projects

Ductwork Evaluation

Specifications

Specification 4937S2 requested a firm price, lump sum bid to supply and shop fabricate ductwork. The ductwork for the TOXECON™ Retrofit Project at Presque Isle Units 7, 8 and 9 is to connect the existing Units discharges to the new fabric filter. The scope of work for the contract includes:

- Preparation of fabrication drawings
- Preparation of erection drawings with tonnage of individual duct sections.
- Submittal of fabrication drawings for engineer review.
- Submittal of erection drawings for engineer review.
- Submittal of all material and coatings information for engineer review.
- Fabrication of ductwork and associated assemblies.
- Fabrication and insertion of internal flow devices.
- Fabrication, attachment as required, and loose shipment as required of ports/flanges.
- Receipt of static mixer from supplier and install in ducts per manufacturer's installation instructions.
- Application of required coatings for ductwork.
- Procurement, attachment as required, and loose shipment as required of slide plate assemblies.
- Testing and inspection as required by specification.
- Shipment of all fabricated ductwork and associated assemblies to site.
- Technical support for interpretation of erection drawings.
- Field support for resolution of fit-up errors or complications.

The specification defined a scope of material supply, shop fabrication, and delivery. Installation/erection of the ductwork will be assigned to the Erection Contractor.

Commercial Evaluation Criteria

Terms and Conditions
Terms of Payment

Economic Evaluation Criteria

Overall Price
Unit Rates
Schedule
Extent of Shop Fabricated Assemblies

Intangible Criteria

Experience with Comparable Projects

Appendix B -
Statement of Project Objectives

The primary goal of this project is to reduce mercury emissions from three 90-MW units at the We Energies Presque Isle Power Plant. Additional goals are to reduce nitrogen oxide (NO_x), sulfur dioxide (SO_2), and particulate matter (PM) emissions; allow for reuse and sale of fly ash; develop and demonstrate a reliable mercury continuous emission monitor (CEM) suitable for use in the power plant environment; and demonstrate a process to recover mercury captured in the sorbent. To achieve these goals, We Energies (the Participant) will design, install, and operate a TOXECON™ system designed to clean the combined flue gases of units 7, 8, and 9 at the Presque Isle Plant.

TOXECON is a patented process in which a fabric filter system (baghouse) installed downstream of an existing particulate control device is used in conjunction with sorbent injection for removal of pollutants from combustion flue gas. The flue gas emissions will be controlled from the three units using a single baghouse. Mercury will be controlled by injection of activated carbon or other novel sorbents, while NO_x and SO_2 will be controlled by injection of sodium-based or other novel sorbents. Addition of the TOXECON baghouse will provide enhanced PM control. Sorbents will be injected downstream of the existing particle collection device to allow for sale and reuse of captured fly ash that is uncontaminated by activated carbon or sodium sorbents.

Methods for sorbent regeneration, i.e. mercury recovery from the sorbent, will be explored and evaluated. Components available for use will be evaluated and the best available will be integrated into a mercury CEM suitable for use in the power plant environment. This demonstration will provide for the use of a novel multi-pollutant control system to reduce emissions of mercury and other air pollutants, while minimizing waste, from a coal-fired power generation system.

A. Project Objectives

The specific objectives of this project are to demonstrate the operation of the TOXECON multi-pollutant control system and:

- achieve 90% mercury removal from flue gas through activated carbon injection,
- evaluate the potential for 70% SO2 control and trim control of NOx from flue gas through sodium-based or other novel sorbent injection,
- reduce PM emission through collection by the TOXECON baghouse,
- recover 90% of the mercury captured in the sorbent,
- utilize 100% of fly ash collected in the existing electrostatic precipitator,
- demonstrate a reliable, accurate mercury CEM suitable for use in the power plant environment,
- successfully integrate and optimize TOXECON system operation for mercury and multi-pollutant control.

The Participant will design and construct a TOXECON multi-pollutant control system as a retrofit to three 90-MW coal-fired boilers at the Presque Isle Power Plant. The objectives will be achieved through injection of various sorbents into the flue gas stream to capture

mercury, SO_2, NO_x, and other air toxics as appropriate. Efforts will be focused on development and demonstration of two ancillary technologies, a mercury continuous emission monitor and a method of treating the captured activated carbon sorbent for regeneration or for reuse in the system rather than disposal. The demonstration project will provide the utility industry a benchmark for cost and performance of a commercial scale mercury control systems for application on coal-fired power generation systems.

B. Scope of Project

The "TOXECON™ Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers" project will be completed in two Budget Periods. These two Budget Periods are:

Budget Period 1: Project Definition, Design& Engineering, Prototype Development, Major Equipment Procurement, and Foundation Installation.

Budget Period 2: CEM Demonstration, TOXECON Erection, TOXECON Operation, and Carbon Ash Management Demonstration.

As indicated by the title, Budget Period 1 will initiate the project with project definition activities including NEPA, followed by design, which includes specification and procurement of long lead-time major equipment, and installation of foundations. In addition, prototype development for mercury CEM and sorbent regeneration processes will be conducted.

Following in Budget Period 2, the TOXECON system will be constructed and operated. Operation will include optimization for mercury control, parametric testing for SO_2 and NO_x control, and long term testing for SO_2 and NO_x control. The mercury CEM and sorbent regeneration processes will be demonstrated in conjunction with the TOXECON system operation.

C. Tasks to be Performed

(The Participant will work directly with the company identified in the parentheses.)

Budget Period 1: Project Definition, Design and Engineering, Prototype Development, Major Equipment Procurement, Foundation Installation, and Management and Reporting.

Task 1 - Design Review Meeting (ADA-ES)

The project team will hold a Kickoff Design Review Meeting including the Participant, the DOE Contracting Officer's Representative (COR), major subcontractors, and other project team members as appropriate to discuss the project, system hardware components, costs, and schedules. This meeting will take place within sixty days after award with the primary

purpose of providing a status of the ongoing work, specifying system requirements, and planning future project activities.

Task 2 – Project Management Plan (ADA-ES)

An updated Project Management Plan will be prepared as a deliverable within thirty days following the Design Review Meeting. This plan will be updated based on information provided at the Design Review Meeting held under Task 1. The plan will be suitable for use in tracking project progress at the task level using the earned value management system and will include the following information.

- Final Work Breakdown Structure. A final Work Breakdown Structure will be prepared that identifies Tasks and Subtasks to be performed under the project.
- Final Statement of Project Objectives. A final Statement of Project Objectives will be prepared that describes the work to be performed under the project at the Task and Subtask level of detail, following the format of the Work Breakdown Structure.
- Schedule Baseline. A Schedule Baseline will be prepared in Gantt Chart format that shows the project schedule for the entire project at the Task level of detail, including major milestones and decision points. The Schedule Baseline will follow the Task structure of the Work Breakdown Structure.
- Cost Baseline. A Cost Baseline will be prepared showing projected monthly total project cost as a function of Task, following the format of the Work Breakdown Structure.
- Technology Baseline. A description of the Baseline Technology will be prepared, including a summary of technology experience and applications, design issues to address as identified in the Design Review Meeting, mass balances, and identification of major equipment.
- Management Controls. An updated listing of key organizations and individuals involved with the project, functions and authorities of each, lines of authority, procedures used to control cost expenditures, and technical decision-making procedures.

Task 3 – Provide NEPA Documentation, Environmental Approvals Documentation, and Regulatory Approval Documentation (ADA-ES)

The Participant will provide a completed Environmental Information Volume and other information to DOE and any DOE-authorized subcontractors necessary to allow completion of the Environmental Assessment required for compliance with the National Environmental Policy Act (NEPA). The Participant will provide documentation to DOE demonstrating that the participant has the necessary approvals from appropriate environmental regulatory bodies to proceed with the project. The Participant will provide any rulings received from state public utilities commissions regarding this project to DOE.

Task 4 – Balance of Plant (BOP) Engineering (C&B)

In addition to the major process equipment, ductwork, and distributed control systems (DCS) described herein, a substantial balance of plant engineering and design effort is required. The Participant will provide BOP engineering and design necessary for the construction, installation, and operation of the TOXECON technology. The Participant will subject the BOP design to standard engineering review and acceptance procedures. The BOP engineering and design scope includes the following items.

- Demolition, excavation, and underground utility relocation design.
- Baghouse arrangement and plant equipment general arrangement design.
- Foundation design.
- Civil, structural, and ductwork design.
- Baghouse and building enclosure design.
- Mechanical design, including fans, ductwork, dampers, sorbent handling silo, and air compressors.
- Electrical system study, motor control center (MCC), and electrical design.
- Plant controls and instrumentation design, and CEM design.
- Piping and instrumentation diagrams, and piping design for carbon, water, air, sorbent/ash, and flue gas subsystems.
- Water injection skid system design.
- Carbon injection skid systems design.

For each BOP design item, the Participant will provide a definition of design scope, appropriate drawings, specifications, and instructions sufficient for the construction, installation, and operation of TOXECON system. The participant will subject the BOP design to standard engineering review and acceptance procedures.

Task 5 – Process Equipment Design and Major Equipment Procurement (C&B)

The Participant will provide expertise in the development of the final design and specifications for the TOXECON technology. Major equipment bid packages will be prepared and awarded in this task.

Subtask 5.1 – Process Equipment Design

The Participant will provide a design for the TOXECON system to be installed at the Presque Isle Plant. The Participant will provide the final design and specifications for the baghouse and sorbent injection system, which are the major components that must be integrated in the TOXECON technology. The baghouse will be capable of processing the combined flue gases of units 7, 8, and 9 at the Presque Isle Plant. The baghouse will be capable of filtering activated carbon sorbent and other sorbents used in the TOXECON system, and shall be sized appropriately such that sufficient sorbent can be injected to meet project pollution reduction goals as stated in Section A, Project Objectives. The sorbent injection system will be capable of injecting activated carbon and other sorbents in sufficient quantity to meet project pollution

reduction goals. Performance data from ongoing, non-commercial demonstrations will be included in the design as appropriate. Flow modeling will be performed to confirm design parameters. Process instrumentation necessary to track performance will be specified.

Subtask 5.2 – Major Equipment Procurement

Formal specifications and bid packages will be prepared, negotiated, and awarded as appropriate. Equipment packages include baghouse, demolition, and underground work; foundation, mechanical and steel; electrical and controls; sorbent silo and sorbent handling system; ID fans and motors; and air compressors.

Task 6 – Prepare Construction Plan (C&B)

The Participant will develop a Construction Plan that identifies and describes all crucial activities required for an on-time completion of the design, procurement, construction, and start-up phases of the project. The Construction Plan will include a Project Plan that will specify material types and quantities, labor craft requirements, and schedules necessary for the successful construction of the TOXECON system. The Construction Plan will also include a detailed Gantt chart that will identify design, procurement, construction, and start-up activity schedules with all critical path items and milestones identified. The Construction Plan Gantt chart will be used to coordinate activities among subcontractors, and to track progress of activities against a baseline schedule to assist in maintaining the project schedule.

Task 7 – Procure Mercury Continuous Emission Monitor (CEM) Package and Perform Engineering and Performance Assessment (ADA-ES)

Mercury CEM components will be selected and procured. The Participant will assess the suitability of commercially available equipment to the needs of this program. The Participant will evaluate mercury CEM components and incorporate the various components into a fully functional mercury CEM capable of measuring mercury content of a coal-fired flue gas stream suitable for evaluating performance of the TOXECON system. The mercury CEM should allow for automated operation, requiring only periodic operation and maintenance by plant operating personnel. It is a goal of this program to work with suppliers to significantly improve reliability and decrease operations and maintenance requirements of currently available mercury CEM devices. Two subtasks will be performed in Budget Period 1.

Subtask 7.1 – System Design, Evaluation, and Analysis (Laboratory and Field)

The Participant will evaluate mercury CEM components including the extraction, detector, calibration, sample transport, conversion and separation, and control and data management subsystems. The participant will survey existing components for availability and suitability for integration into a mercury CEM system. The participant will perform laboratory and/or field testing as appropriate of each individual subsystem to determine its suitability based on criteria stated above. The Participant will procure suitable components for system integration testing.

Subtask 7.2 – System Integration and Testing

The Participant will integrate components procured in Subtask 7.1 into an operational mercury CEM device. The Participant will perform necessary laboratory evaluations and system checkout procedures to ensure proper operation and suitability prior to field evaluations. The Participant will develop written operating instructions for the mercury CEM system and an evaluation plan, including performance criteria, to assess mercury CEM system performance.

The Participant will perform a field evaluation at a coal-fired power generation facility to assess the performance of the mercury CEM against criteria established above according to the Evaluation Plan identified above.

Task 8 – Mobilize Contractors (C&B)

The Participant will mobilize contractors based on the project schedule in accordance with the Construction Plan developed under Task 6. This includes construction management, demolition and excavation, mechanical, electrical, and foundation contractors. Mobilization is the first step in granting authorization for contractors to initiate work. Mobilization includes installing the temporary construction infrastructure required before crews arrive on site, hiring personnel and subcontractors, and developing a utilization plan for large equipment including cranes.

Task 9 – Foundation Erection (C&B)

After all required demolition work, relocation of below-grade equipment, and earthwork has been completed, foundations for all major equipment will be installed. Work will be performed in accordance with design specifications developed under Tasks 4 and 5, and in accordance with the Completion Plan developed in Task 6.

The existing paved parking lot and other existing structures as required will be demolished and scrap material will be disposed of in an appropriate manner. Excavation will be performed to expose below-grade equipment and utilities, including storm pipe, trench drains, fire suppression water, and water as appropriate. These utilities will be relocated to allow for installation of the TOXECON system. New below-grade utilities required for installation and operation of the TOXECON system will be installed. General excavation will be performed to prepare for construction of foundations for all major pieces of equipment. Concrete foundations will be installed for the baghouse, sorbent injection equipment, water injection skids, and other equipment as required for the installation and construction of the TOXECON system. Roads disturbed during foundation erection will be restored, suitable for supporting access to plant operations. Large equipment will be deployed as required by the Large Equipment Deployment Plan developed in Task 8.

Task 17 – Carbon-Ash Management System (ADA-ES)

Subtask 17.1 – Evaluate Options and Pilot Test Carbon-Ash Management System

The Participant will evaluate the viability of a mercury recovery system for the purpose of recovering mercury from the sorbent/ash mixture and allowing for beneficial reuse of this product. The Participant will also evaluate the processed sorbent for potential reuse. This may also allow the sorbent to be recycled in the TOXECON system. Activities to be performed under this budget period will include the following. The Participant will perform a survey to identify potential technology options. From these options, a technology will be chosen for further study. The Participant will evaluate the viability of the system and approach through engineering analysis and laboratory and/or pilot scale testing.

Task 19 – Reporting, Management, Subcontracts, Technology Transfer (ADA-ES)

The Participant will employ standard project management techniques for the purpose of keeping all activities on schedule and within the budget. Activities performed under this task will be used to provide oversight and control throughout execution of the project during Budget Period 1. The Participant will hold team meetings with attendance required from the organizations most involved during the active phase of the project to facilitate communication and enable the appropriate technical input into all activities.

The Participant will prepare and submit reports as required in the Financial Assistance Reporting Requirements Checklist and this Statement of Project Objectives. The Participant will report data such that earned value management techniques can be used to evaluate progress of Tasks under Budget Period 1. Non-proprietary technical progress reports will be distributed among team members to keep the team informed of the project status. Subcontract management, communications, outreach, and technology transfer functions will also be performed under this task.

Budget Period 2: CEM Demonstration, TOXECON Erection, TOXECON Operation, Carbon-Ash Management Demonstration, and Management and Reporting.

Task 7 – Procure Mercury CEM Package and Perform Engineering and Performance Assessment (ADA-ES)

Subtask 7.3 – Mercury CEM Design, Component Integration, and Field Testing

Efforts to develop a mercury CEM will continue in Budget Period 2. Tasks in this period will focus on integrating components, field testing, and final design issues that have not been addressed in Subtask 7.2. Based on testing performed in Budget Period 1, overall system performance and performance of individual system components will be evaluated. Redesign of the system and individual components will be performed as required. Appropriate modifications, including acquisition and integration of new components, will be made to the prototype device to address

system deficiencies. Further laboratory evaluations, system check out, and field evaluations will be performed as required. The prototype monitor will be installed on the TOXECON system.

Task 10 – Erect Structural Steel, Baghouse, and Ductwork (C&B)

The Participant will construct and install structural steel, ductwork, a sorbent injection system and a baghouse necessary for the operation of the TOXECON mercury removal and multi-pollutant control system. The Participant will construct and install equipment specified and procured in Task 5 in accordance with designs developed in Tasks 4 and 5. Activities will be performed in accordance with the Completion Plan developed in Task 6.

The Participant will install structural steel necessary to support the multi-level duct arrangement, baghouse, induced draft fan enclosure, access and instrumentation supports, sorbent silo, and all other equipment necessary for operation of the TOXECON system.

Stiffened plate steel ductwork will be installed that allows flue gas from Presque Isle Units 7, 8, and 9 to enter the TOXECON baghouse or exit directly to the existing stack. Ductwork will also be installed to carry flue gas from the TOXECON baghouse, which will transition from a single duct into three, each with an induced draft fan, to carry flue gas to existing independent outlet ducts for Units 7, 8, and 9.

The Participant will install a baghouse to filter the combined flue gas streams of Units 7, 8, and 9 at the Presque Isle Plant. The baghouse shall be capable of filtering activated carbon sorbent and other sorbents used in the TOXECON system, and shall be sized appropriately such that sufficient sorbent can be injected to meet project pollution reduction goals as stated in Section A, Project Objectives.

The Participant will install steel platforms to serve as working surfaces allowing performance of standard maintenance on equipment and access to test ports and probes. These areas include access inside the existing powerhouse to the exhaust duct water injection ports, if required, and access to baghouse inlet and outlet ducts.

Task 11 – Balance of Plant Mechanical and Civil/Structural Installations (C&B)

The Participant will construct and install mechanical balance of plant equipment necessary for operation of the TOXECON system according to designs developed in Tasks 4 and 5, including equipment specified and procured under Task 5. Activities will be performed in accordance with the Completion Plan developed in Task 6. Balance of plant mechanical installations will include the following:

- Baghouse and duct insulation and lagging
- Hopper, fan, and silo enclosures and siding
- Sorbent/Ash vacuum exhauster skids and enclosure
- Piping, valves, support, and accessories
- Sorbent/Ash silo and unloading equipment

- Induced draft fans
- Instrument air and controls system
- Carbon injection system
- Unit tie-ins
- Heating, ventilation, air conditioning, fire protection, and support systems
- Water injection system
- Miscellaneous guard post and guardrails

Task 12 – Balance of Plant Electrical Installations (C&B)

The Participant will install balance of plant electrical equipment necessary for operation of the TOXECON system according to designs developed in Tasks 4 and 5, including equipment specified and procured under Task 5. Activities will be performed in accordance with the Completion Plan developed in Task 6. Balance of plant electrical installations will include the following:

- Baghouse power supply
- Three MCCs
- ID fan power supply
- Auxiliary electrical supply
- Baghouse control cable
- ID fan control cable
- Auxiliary equipment control cable
- CEMS system
- DCS system
- Freeze protection system
- Lighting system

Task 13 – Equipment Pre-Operational Testing (C&B)

Prior to start-up of the TOXECON system, each major and minor piece of equipment will be powered up and tested to assure that operation meets performance specifications. This includes all fans, blowers, compressors, support instrumentation, control systems, valves, dampers, and plant tie-ins. Pre-operation testing will include:

- ID fan startup and checkout
- Baghouse systems startup and checkout
- Air compressor checkout
- Carbon injection system checkout
- Sorbent/Ash handling system checkout
- Water Injection system checkout
- Instrument and controls systems checkout
- DCS programming checkout
- CEMS system checkout
- Electrical systems checkout

Task 14 – Start Up and Operator Training (C&B)

The Participant will devote sufficient time to allow for successful start up and debugging of full system operation. The Participant will conduct operator training during the start-up period. The Participant will develop operating manuals and distribute copies to operating personnel sufficient for training and operation of the TOXECON system. Training will take place in several forms including classroom sessions for all pertinent personnel.

Task 15 – Operate, Test, Analyze Data, and Optimize TOXECON for Mercury Control (ADA-ES)

Subtask 15.1 – Test Plan Development

The Participant will develop Test Plans for each major area of investigation. The Participant will develop Test Plans with input from team members as appropriate. Test Plans will be subject to review by team members prior to submission to DOE for comment. The Participant will develop Test Plans for evaluating and optimizing the TOXECON technology including:

- TOXECON Evaluation
- Mercury Recovery
- Mercury CEM

The Participant shall submit a Draft Copy of each Test Plan to the DOE COR for review. The COR shall review each Test Plan and provide comments to the Participant within thirty days of receipt. The Participant shall address comments made by the DOE COR and submit a Final Copy of each Test Plan to the DOE COR for approval. The COR will provide approval of each Final Test Plan that fully addresses COR comments within thirty days of receipt. The Participant shall not initiate testing prior to completion of the Test Plan approval process.

TOXECON Evaluation Test Plan. The Participant will develop a Test Plan to evaluate mercury and multi-pollutant control through sorbent injection, and a plan to optimize TOXECON operation for maximum mercury and multi-pollutant removal under varying operating conditions. The Test Plan will address the following issues:

- A plan for start-up, optimization, long-term performance monitoring and acceptance testing of TOXECON for mercury control under varying operating conditions. Operating strategies for optimizing mercury control including but not limited to temperature control will be addressed.
- A plan and schedule for monitoring mercury entering TOXECON and mercury emissions, including demonstrating integrated operation of all subsystems and components. A plan and schedule for periodic manual stack measurements of both particulate matter and mercury. A plan and schedule for measurement of NOx and SO2 emission reduction.

- Sorbents and suppliers of sorbents for mercury, NOx and SO2 removal will be identified.
- A plan for evaluating fabric filter bags selected for use to determine their suitability for continued testing. Bag integrity through periodic bag strength testing, and measurement of as-received, vacuumed, and in situ bag permeability will be conducted.
- Operating data to be tracked including but not limited to temperature, pressure drop, cleaning frequency, sorbent injection rate, and opacity will be identified.
- A plan for short-term, parametric tests to evaluate alternate activated carbon sorbents and operating strategies.
- A plan for evaluating and optimizing the control of SO2 and NOx through sorbent injection under varying operating conditions. A plan for investigating waste disposal and mercury recovery from these sorbents.

Mercury Recovery Test Plan. The Participant will develop a Test Plan to evaluate performance of the mercury recovery system developed under Task 17. The Participant will fully evaluate the ability of the chosen system to recover mercury from spent activated carbon sorbent and the feasibility of reuse of the sorbent in the TOXECON system. The plan will include an evaluation of methods for disposing of the mercury captured in the mercury recovery system.

Mercury CEM Test Plan. The Participant will develop a Test Plan to evaluate the performance of the mercury CEM developed under Task 7. The CEM will be evaluated on the full scale TOXECON system. The plan will be designed to evaluate the operability and reliability of the instrument. The plan will be designed to evaluate the accuracy and reproducibility of mercury emission measurements.

Subtask 15.2 – Optimize TOXECON for Mercury Control

The Participant will operate the TOXECON system in accordance with the TOXECON Evaluation Test Plan developed under Task 15.1. The Participant will operate the TOXECON system to evaluate its performance with respect to mercury control as a function of operating variables. The Participant will evaluate the long-term performance of the TOXECON system, and the Participant will perform short term parametric testing to evaluate alternative sorbents and operating strategies. The Participant will measure mercury emission reductions, evaluate filter bag integrity, and track operating data to quantify TOXECON performance as a function of operating conditions.

Subtask 15.3 – Continuous Mercury Measurements

The Participant will operate the mercury CEM to evaluate the operability, reliability, accuracy, and repeatability of the mercury CEM system in accordance with the Mercury CEM Test Plan developed in Subtask 15.1. The Participant will evaluate the performance of the mercury CEM developed under Task 7 on the full scale

TOXECON system. The mercury CEM will be used to evaluate the performance of the TOXECON system for its ability to control mercury emissions.

Task 16 – Operate, Test, Analyze Data, and Optimize TOXECON for SO_2 and NO_x Control (ADA-ES)

After TOXECON operation and performance is established for mercury control, the Participant will conduct tests to assess the capability of TOXECON to control other pollutants, including SO_2 and NO_x. Injection equipment and measurement instrumentation will be designed, procured, and installed specifically for these tests. The Participant will perform evaluations in accordance with the TOXECON Evaluation Test Plan developed in Subtask 15.1. The Participant will measure SO_2 and NO_x emission reductions and track operating data to quantify TOXECON performance as a function of operating conditions.

Task 17 – Carbon-Ash Management System (ADA-ES)

Subtask 17.2 – Procure Full-Scale Demonstration System and Evaluate Carbon-Ash Management System

Providing that the results from Subtask 17.1 meet project goals, the Participant will procure a full-scale demonstration unit of the mercury recovery system for testing of the sorbent-ash mixture collected in TOXECON. The Participant will install the mercury recovery system on the TOXECON system to allow for continuous removal and processing of the spent sorbent and ash mixture from the TOXECON system. The Participant will perform shakedown testing to ensure proper operation of all subsystems and the integrated system as a whole prior to incorporation into the TOXECON system. The Participant will evaluate the performance of the mercury recovery system as installed on the TOXECON system in accordance with the Mercury Recovery Test Plan developed in Subtask 15.1. The Participant will evaluate the ability of the mercury recovery system to evolve mercury from used sorbent in the presence and absence of SO_2 and NO_x sorbents. The Participant will evaluate the ability of the regenerated sorbent to capture mercury. The Participant will evaluate the methods for disposal of mercury captured in the mercury recovery system. Contingent on successful results, the Participant will provide an assessment of the capital and operating costs of the mercury recovery system and provide a cost-benefit analysis relative to inclusion of this system in the TOXECON system.

Task 18 – Revise Design Specifications, Prepare O&M Manuals (ADA-ES)

The Participant will prepare revisions to specifications based on the as-built installation and actual operating experience of the system. The Participant will prepare revised operating and maintenance manuals based on as-built installation and operating experience.

Task 19 – Reporting, Management, Subcontracts, Technology Transfer (ADA-ES)

The Participant will employ standard project management techniques for the purpose of keeping all activities on schedule and within the budget. Activities performed under this task will be used to provide oversight and control throughout execution of the project during Budget Period 2. The Participant will hold team meetings with attendance required from the organizations most involved during the active phase of the project to facilitate communication and enable the appropriate technical input into all activities.

The Participant will prepare and submit reports as required in the Financial Assistance Reporting Requirements Checklist and this Statement of Project Objectives. The Participant will report data such that earned value management techniques can be used to evaluate progress of Tasks under Budget Period 2. Non-proprietary technical progress reports will be distributed among team members to keep the team informed of the project status. Subcontract management, communications, outreach, and technology transfer functions will also be performed under this task.

D. Deliverables

In addition to the reports identified on Attachment B, the Financial Assistance Reporting Requirements Checklist, and in specific sections of this agreement, the Participant shall provide documents, reports, and briefings as identified below.

Project Management Plan. The Participant shall provide an updated Project Management Plan within thirty days of the Design Review Meeting held under Task 1.

Construction Plan. The Participant shall provide a Construction Plan developed under Task 6.

Test Plans. The Participant shall provide the following Draft Test Plans for review by the DOE COR: Draft TOXECON Evaluation Test Plan, Draft Mercury CEM Test Plan, and Draft Mercury Recovery Test Plan. The Participant shall provide the following Test Plans for DOE approval: TOXECON Evaluation Test Plan, Mercury CEM Test Plan, and Mercury Recovery Test Plan.

Topical Report. The Participant shall submit a Preliminary Public Design Report as a Topical Report for Budget Period 1. The Participant shall submit a Draft Topical Report for Budget Period 1 within sixty days of the conclusion of Budget Period 1. DOE shall review the Draft Topical Report and provide comments to the Participant within thirty days of receipt. The Participant shall address DOE comments and submit a Final Topical Report for Budget Period 1 within thirty days.

Public Design Report. The Participant shall submit a Public Design Report, for the purpose of public use. The Public Design Report must consolidate all design and cost information for the project at the completion of construction and start up. The report must contain sufficient

information to provide an overview of the project, salient design features and data, and the role of the demonstration project in commercialization planning.

E. Briefings

Briefings and Technical Presentations shall be provided as follows.

Kickoff Design Review Meeting. The Participant shall hold a Kickoff Design Review Meeting as described in Task 1, within sixty days after award with the primary purpose of providing a status of the ongoing work, specifying system requirements and planning future project activities.

Design Review Meeting. The Participant shall hold a Design Review Meeting near the end of design activities during Budget Period 1 to present a review of the design process and salient design features of the TOXECON system.

Final Briefing. The Participant shall provide a Final Briefing at the conclusion of the project to provide a comprehensive summary of the accomplishments and results of this project. The location of the Final Briefing shall be Morgantown, West Virginia.